Social relationships within and outside a troop in wild male Japanese macaques (Macaca fuscata) in Kinkazan Island, Japan(Digest_要約)

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金華山島に生息する野生ニホンザルのオスの群れ内外における社会関係

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動物の持続的な親和的関係は社会的紐帯とみなされ、血縁関係によってもたらされると考えられてきた。霊長類の多くは、オスが出自群から移籍するオス分散型の社会を持つ。オス分散型の社会では、オス間の血縁が希薄であるだけでなく、繁殖をめぐり互いに競合することから、オス同士の親和的な関係は稀であると考えられてきたが、近年、オス間にも社会的紐帯があり、寛容性や敵対的交渉時の連合形成、それに伴う順位上昇等と関連していると指摘されている。親和的関係を含め、オスの社会関係は群れに在籍する群れオスを対象に研究が行われ、群れに在籍しない群れ外オスの社会関係はこれまでほとんど明らかにされていない。また、優劣関係が緩やかな寛容型マカクを対象とした研究が多く行われているが、優劣関係が厳格な専制型マカクについての知見は少なく、専制型マカクを対象とした研究により、オス間の社会的紐帯の進化過程についての理解が進むことが期待される。本研究では、宮城県金華山島に生息する野生ニホンザル（*Macaca fuscata*）の群れオスだけでなく群れ外オスも調査対象とし、非交尾季における群れオス・群れ外オスの分類の定量的評価、非交尾季と交尾季のオスの親和的交渉、敵対的交渉、連合形成をもとに、群れ内外におけ

るオスの社会的紐帯を示すと共にその機能について明らかにすることを目的とした。

第１章では、非交尾季に野外調査を行い、これまで定性的にしか評価されてこなかった、群れオスと群れ外オスの分類の定量的な評価を行い、非交尾季において、主成分分析により、オスの行動データをもとにした群れオスと群れ外オスへの二分が可能であることを明らかにした。また、この手法が、複雑な社会構造の解明に寄与する大きな可能性を持つことを示した 。群れ外オスのなかに、オスグループを形成していると示唆されるオスがおり、そのようなオス同士は、群れオス同士に比べ、近接割合が低く交渉機会が少ないにもかかわらず高頻度でグルーミング交渉を行っていることが判明した 。また、群れ外オスと群れオスとの間で行われるグルーミングは不均衡で、群れ外オスが群れオスに対し、より多くグルーミング を行っていることを示した。これらの結果は、群れオス同士に比べ、群れ外オス同士では潜在的に集団内競合が弱く親和的になりやすいことや、群れオスからの寛容性を引き出し、群れへの移入 の可能性を高めることと関係していると考えられた。

第２章では、非交尾季とその直後の交尾季に野外調査を行い、オス間の親和的関係と敵対的関係の季節的な変化とそれらの関連を明らかにした。非交尾季に比べ交尾季には、グルーミング交渉の減少と敵対的交渉の増加が認められた。敵対的交渉時の連合形成は交尾季にのみ観察され、優位な個体ほど連合形成に多く関与し、そのほとんどが攻撃者援助であった。また、グルーミング相手の選好性は非交尾季から交尾季にかけて維持されており、連合形成との相関関係

はみられなかったが、頻繁にグルーミングする相手から攻撃を受けることは少なかった。これらの結果は、優劣関係が厳格なニホンザルにおいては、優位個体の反撃のために、劣位個体同士の連合形成が抑制されており、それが優劣関係の維持に寄与していると考えられた。

Social relationships within and outside a troop in wild male Japanese macaques (*Macaca fuscata*) in Kinkazan Island, Japan

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Introduction

Social bonds in animals have been construed as differentiated enduring affiliative social relationships, which is primarily derived from kin relations. In many primates, males disperse from their natal troop. Male–male social bonds have been supposed to be rare because their relatedness is expected to be low and they compete over non-sharable fertile females. Male–male social bonds are, however, widespread phenomena even in male dispersal primate species. Male–male social bonds suggest formation of coalitionary support, social tolerance, and elevation of dominance hierarchy in tolerant macaque species. Coalitions among males are hypothesized to depend on variation in strength of contest competition over females.

Some males do not belong to bi-sexual troops and sometimes form all-male groups. However, little is known about the association patterns and social relationships among them and between troop male and non-troop male. Studies on male–male social bonds and coalition formation have been conducted mainly in tolerant social style. Knowledge

about social relationships in despotic macaque species may contribute to elucidation of evolutional process of male–male social bonds.

Japanese macaques (*Macaca fuscata*) show male dispersal and the most despotic social style among macaque species, and non-troop males are observed in many populations. Male Japanese macaques have been classified qualitatively into troop/non-troop males. In the current study, at first, I employed a novel method for quantitative classification of males based on their behaviour in the non-mating season by principal component analysis, and revealed association patterns, and affiliative relationships in male Japanese macaques. Then, I analysed seasonal change and correlation of affiliation, aggression, and coalition among males. I discussed differentiation and its influence of affiliative relationships among males within and outside a troop.

Methods

I conducted this study in Kinkazan Island, Japan. The island is about 10 km^2 in area and located 700 m from the main island of Japan. Six troops inhabit in the island, and I choose Troop C_2 as the subject troop. Socionomic sex ratio is skewed towards females. I conducted intensive field research in 2007 and 2009.

In 2007, I observed 12 wild male Japanese macaques for 809 h in non-mating season with focal animal sampling. The number of other animals within visual range, the amount of time males spent in the vicinity of other animals, and grooming interactions were recorded. I examined male classification by principal component analysis and analyzed association pattern and grooming frequencies.

In 2009, I observed 7 non-natal adult males including non-troop males for 350 h in non-mating and mating season respectively with focal animal sampling. I recorded grooming, aggressions, and coalitions among males. Presence of other males was also recorded to assess opportunities for social interaction. I analyzed seasonal change and correlation among these behaviours.

Results

In non-mating season, 2007, I could classify males into two distinctive clusters (Cluster 1 and 2) according to their association and interaction patterns. Cluster 1 males associated with females and participated in grooming with them. Cluster 2 males had less visual encounters with females and did not groom them. Although Cluster 2 males showed less proximity one another than Cluster 1 males did, they frequently exchanged grooming among themselves per proximity time. Cluster 2 males groomed Cluster 1 males more frequently than they were groomed.

Compared to non-mating season in 2009, subsequent mating season was characterized by decreased rate of grooming and increased rate of aggression. Coalition was observed only in mating season, and most of them were winner support. Linearity of dominance hierarchy was found in mating season but not in non-mating season. The higher ranking male involved the more frequent coalitions. Frequencies of grooming given in the non-mating season did not correlate with those of coalition received in the subsequent mating season but negatively correlated with those of aggression received in the mating season.

Discussion

The result of principal component analysis suggested that Cluster 1 were troop males, and Cluster 2 were non-troop males. This means that males could be separated quantitatively by their behaviour. This method might contribute to clarifying the complexity of social structures. Non-troop males might have less opportunity to interact with females and form less cohesive all-male groups. Males in all-male groups engaged in more frequent grooming than troop males did, and they groomed troop males more frequently than they were groomed. Male–male affiliative relationships might be influenced by within-group potential competition.

Results of correlation among grooming, aggressions, and coalitions between two seasons suggested that social bonds construed as grooming relationships did not predict coalitions but social tolerance in despotic macaques. More grooming to troop males in non-troop males might derive social tolerance from troop males, which might enable non-troop males to approach fertile females in mating season or immigrate into a troop in near future.

Most of coalitions were winner supports. Coalitions among subordinates against dominant males might be suppressed because of high risk of counter aggression and little benefits for mating opportunities. The lack of coalitions among subordinates might contribute to stable dominant hierarchy in despotic macaques.